

WHAT IS CLAIMED IS:

1. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

5 replacement means for replacing lower n bits of an m -bit image signal with n -bit additional information, and outputting an m -bit conversion image signal;

error calculation means for calculating an error between the m -bit conversion image signal replaced by 10 the replacement means and the m -bit image signal before the replacement;

an error buffer for storing the error calculated by the error calculation means;

15 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

20 error correction means for correcting the m -bit image signal before the replacement, using the weight error calculated by the weight error calculation means; and

25 extraction means for extracting the lower n bits of the m -bit conversion image signal replaced and output from the replacement means.

2. An image processing apparatus according to

claim 1, wherein the m-bit conversion image signal is only a specific color component of color-separated color image signals.

5 3. An image processing apparatus according to claim 1, wherein the m-bit image signal before the replacement is a color difference component of a color image signal represented by a luminance and a color difference.

10 4. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

multi-value means for subjecting an m-bit image signal to a multi-value process and converting the m-bit image signal to an m-n bit image signal;

15 error calculation means for calculating an error between the m-n bit image signal multi-value-processed by the multi-value means and the m-bit image signal before subjected to the multi-value process;

20 an error buffer for storing the error calculated by the error calculation means;

weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

25 weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

error correction means for correcting the m-bit

image signal before the multi-value process, using the weight error calculated by the weight error calculation means;

addition means for adding n-bit information to
5 the m-n bit image signal multi-valued-processed by the multi-value means, and outputting an m-bit conversion image signal;

first extraction means for extracting information bits of n bits from the m-bit conversion image signal
10 output from the addition means; and

second extraction means for extracting image bits of m-n bits from the m-bit conversion image signal output from the addition means.

5. An image processing apparatus wherein a first
15 processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

first replacement information pixel determination means for specifying n pixels within j × k pixels;

replacement means for replacing, where the first
20 replacement information pixel determination means has determined that process target pixels are specific n pixels, specific bits of an m-bit image signal with specific bits of n-bit additional information, and outputting an m-bit conversion image signal;

25 second replacement information pixel determination means for specifying n pixels within j × k pixels; and

information bit extraction means for extracting,

where the second replacement information pixel determination means has determined that process target pixels are specific n pixels, specific bits of the m-bit conversion image signal output from the replacement means, and reconstructing information bits of n bits within the $j \times k$ pixels.

6. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

10 first replacement information pixel determination means for specifying n pixels within $j \times k$ pixels;

15 replacement means for replacing, where the first replacement information pixel determination means has determined that process target pixels are specific n pixels, specific bits of an m-bit image signal with specific bits of n-bit additional information, and outputting an m-bit conversion image signal;

20 error calculation means for calculating an error between the m-bit conversion image signal replaced by the replacement means and the m-bit image signal before the replacement;

25 an error buffer for storing the error calculated by the error calculation means;

 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

 weight error calculation means for calculating a weight error by multiplying the error stored in the

error buffer by the weight coefficient stored in the weight coefficient storage means;

5 error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means;

second replacement information pixel determination means for specifying n pixels within $j \times k$ pixels; and

10 information bit extraction means for extracting, where the second replacement information pixel determination means has determined that process target pixels are specific n pixels, specific bits of the m-bit conversion image signal replaced and output from the replacement means, and reconstructing information bits of n bits within the $j \times k$ pixels.

15 7. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

first replacement information pixel determination means for specifying n pixels within $j \times k$ pixels;

20 replacement means for replacing, where the first replacement information pixel determination means has determined that process target pixels are specific n pixels, lower n bits of an m-bit image signal with n-bit additional information, and outputting an m-bit conversion image signal;

25 error calculation means for calculating an error between the m-bit conversion image signal replaced by

the replacement means and the m-bit image signal before the replacement;

an error buffer for storing the error calculated by the error calculation means;

5 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the
10 weight coefficient storage means;

error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means;

second replacement information pixel determination
15 means for specifying n pixels within $j \times k$ pixels; and

extraction means for extracting, where the second replacement information pixel determination means has determined that process target pixels are specific n pixels, the lower n bits of the m-bit conversion image
20 signal replaced and output from the replacement means.

8. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in l bits, the apparatus comprising:

25 multi-value means for subjecting an m-bit image signal to a multi-value process and converting the m-bit image signal to an $l-n$ ($n < l < m$) bit image signal;

error calculation means for calculating an error between the l-n bit image signal multi-value-processed by the multi-value means and the m-bit image signal before subjected to the multi-value process;

5 an error buffer for storing the error calculated by the error calculation means;

 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

10 weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

15 error correction means for correcting the m-bit image signal before the multi-value process, using the weight error calculated by the weight error calculation means;

20 addition means for adding n-bit information to the l-n bit image signal multi-valued-processed by the multi-value means, and outputting an l-bit conversion image signal;

 first extraction means for extracting information bits of n bits from the l-bit conversion image signal output from the addition means; and

25 second extraction means for extracting image bits of l-n bits from the l-bit conversion image signal output from the addition means.

9. An image processing apparatus wherein a first

processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

multi-value dithering means for subjecting an m -bit image signal to a multi-value process and
5 converting the m -bit image signal to an $m-n$ bit image signal;

addition means for adding n -bit information to the $m-n$ bit image signal multi-valued-processed by the multi-value dithering means, and outputting an m -bit
10 conversion image signal;

first extraction means for extracting information bits of n bits from the m -bit conversion image signal output from the addition means; and

second extraction means for extracting image bits of $m-n$ bits from the m -bit conversion image signal output from the addition means.

10. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

20 difference information extraction means for extracting a difference of n -bit additional information of successive two pixels;

replacement means for replacing where the difference extracted by the difference information
25 extraction means is not 0, n bits from lower $n+1$ bits of an m -bit image signal with additional information, a least significant bit with 1, and also replacing, where

the difference extracted by the difference information extraction means is 0, the least significant bit with 0, and outputting an m-bit conversion image signal;

error calculation means for calculating an error between the m-bit conversion image signal replaced by the replacement means and the m-bit image signal before the replacement;

an error buffer for storing the error calculated by the error calculation means;

weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means; and

extraction means for extracting the lower n bits of the m-bit conversion image signal replaced and output from the replacement means.

11. An image processing apparatus wherein a first processing circuit and a second processing circuit are connected in m bits, the apparatus comprising:

first replacement bit determination means for specifying n bits in an m-bit image signal;

replacement means for replacing the n bits specified by the first replacement bit determination means with n-bit additional information, and outputting an m-bit conversion image signal;

5 error calculation means for calculating an error between the m-bit conversion image signal replaced by the replacement means and the m-bit image signal before the replacement;

10 an error buffer for storing the error calculated by the error calculation means;

weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

15 weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

error correction means for correcting the m-bit image signal before the replacement, using the weight error calculated by the weight error calculation means;

20 second replacement bit determination means for specifying n bits in the m-bit image signal; and

extraction means for extracting the n bits specified by the second replacement bit determination means from the m-bit conversion image signal output 25 from the replacement means.

12. An image processing apparatus wherein a first processing circuit and a second processing circuit are

connected in m bits, the apparatus comprising:

conversion means for converting n -bit additional information to a random n -bit string;

5 replacement means for replacing lower n bits of an m -bit image signal with the random n -bit string converted by the conversion means, and outputting an m -bit conversion image signal;

10 error calculation means for calculating an error between the m -bit conversion image signal replaced by the replacement means and the m -bit image signal before the replacement;

an error buffer for storing the error calculated by the error calculation means;

15 weight coefficient storage means for prestoring a weight coefficient for calculating a weight error;

weight error calculation means for calculating a weight error by multiplying the error stored in the error buffer by the weight coefficient stored in the weight coefficient storage means;

20 error correction means for correcting the m -bit image signal before the replacement, using the weight error calculated by the weight error calculation means;

25 extraction means for extracting lower n bits of the m -bit conversion image signal replaced and output from the replacement means; and

inverse conversion means for subjecting the lower n bits extracted by the extraction means to an inverse

conversion of the conversion by the conversion means.